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To cite this article: Fagbeminiyi Fasina, Gbolahan Oni, Dominic Azuh & Akpovire Oduaran | (2020) Impact of mothers' socio-demographic factors and antenatal clinic attendance on neonatal mortality in Nigeria, Cogent Social Sciences, 6:1, 1747328, DOI: [10.1080/23311886.2020.1747328](https://doi.org/10.1080/23311886.2020.1747328)

To link to this article: <https://doi.org/10.1080/23311886.2020.1747328>



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Published online: 06 Apr 2020.



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Received: 15 October 2019
Accepted: 17 March 2020

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Reviewing editor:
Emmanuel O Amoo, Demography and Social Statistics, Covenant University, Nigeria, Nigeria

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SOCIOLOGY | RESEARCH ARTICLE

Impact of mothers' socio-demographic factors and antenatal clinic attendance on neonatal mortality in Nigeria

Fagbeminiyi Fasina^{1,2*}, Gbolahan Oni¹, Dominic Azuh¹ and Akpovire Oduaran²

Abstract: Neonatal death is often referred to maternal complications during pregnancy, and other exogenous factors that exist around the time of birth or shortly after birth. The United Nations Sustainable Development Goals (UNSDG)-Goal 3, Targets 3.2 aimed at ending preventable deaths of newborns by demanding that all countries should reduce neonatal mortality to 12 per 1000 live births by 2030. The objective of the study was to examine the relationship between mothers' socio-economic and demographic factors on neonatal deaths in Nigeria. The study used quantitative data from the 2013 Nigeria Demographic and Health Surveys (NDHS). The data analyzed consisted of 26,826 women aged 15–49 years who had a live or dead birth within the 5 years preceding the survey. STATA 12 computer software was used to carry out data analyses. Data analyses were at univariate (frequency distribution), bivariate (chi-square) and due to the dichotomous nature of the outcome variable (i.e., whether a child was born alive or dead during the delivery; coded as (1, 0), a binary logistic regression was carried out to examine the

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PUBLIC INTEREST STATEMENT

Childhood mortality, including newborn deaths, remains high and the rate of reduction is slow. Our study highlighted that inadequate antenatal care both in terms of coverage and quality has been associated with these challenges. Hence, it is crucial to increase the coverage of intervention measures before, during and after pregnancy in order to sustain child survival particularly the neonates. These interventions could enhance the achievement of United Nations Sustainable Development Goals (UN-SDG-3) including the associated targets (target 3.2) of ending preventable deaths of newborns.

relationships between various socio-demographic factors, antenatal clinic attendance and neonatal mortality in Nigeria. The results, among others, revealed that background factors of the women such as age, region, residence, education, and wealth status have a significant association with neonatal mortality ($P < 0.05$). The study also found that adequate antenatal clinic attendance helps to reduce neonatal deaths. The study recommended that women should be encouraged to observe regular antenatal clinic visits during pregnancy and also go for institutional delivery for possible reduction of neonates and infant deaths in Nigeria.

Subjects: Health; Health and Poverty; Inequality; Medical Access; Mortality; Population Health

Keywords: antenatal visit; demographic factors; neonatal mortality; socio-economic factors; Sustainable Development Goals

JEL: I12; I14; I18

1. Introduction

The first 28 days of life, the phenomenon of neonatal period happened to be the most vulnerable time for a child's survival in most parts of the world. Children face the highest risk of dying in their first month of life at an average global rate of 18 deaths per 1,000 live births in 2018 (UN IGME, 2019). Relatively, it has been opined that the possibility of dying after the first month but before reaching age 1 is 11 per 1,000 live births and after age 1 but before turning age 5 is 10 per 1,000 live births (UN IGME, 2019). Hence, globally, 2.5 million children died in the first month of life in 2018, approximately to about 7,000 neonatal (newborn) deaths every day, most of which are close to three quarters dying, with one-third dying on the first day, amounting to 47% of all child deaths under the age of 5 years, up from 40% in 1990 (Child Trends, 2019; UN IGME, 2019; WHO, 2019). It has been observed that most sub-Saharan African countries had the highest neonatal mortality rate in 2018 at 28 deaths per 1,000 live births, followed by Central and Southern Asia with 25 deaths per 1,000 live births (WHO, 2019). It has also been observed by UN IGME, 2019, that Nigeria neonatal record is among the worst in the world. This is based on the facts that, there is no evidence to suggest that more neonates are surviving in Nigeria community today as compared to decade years ago, despite efforts made and celebrated by millennium development goals (MDG) campaign across the world (UN IGME, 2019; WHO, 2019).

Presently, neonatal contribution to mortality rate below 5 years of age in Nigeria has risen in the last 10 years from 40% to nearly 50% despite the huge expenditure of MDG in Nigeria on importation of ideas and systems (UNICEF & WHO, 2015; UN IGME, 2019). Neonatal mortality (NM) is conceptualized in this study as the death of an infant which occurs within 4 weeks of birth (UN IGME, 2019; WHO, 2006; World Health Organization, 2018a) and the health status of the newborn and the wellbeing of a population. Nigeria is known to have high neonatal, infant and child mortality rates of 37, 69, and 128 per 1000 live births, respectively (National Population Commission, 2017, 2014). The United Nations Sustainable Development Goals (UN-SDG)-Goal 3, Target 3.2, aimed at ending preventable deaths of neonates by demanding that all countries should reduce neonatal mortality to, at least, as low as 12 per 1000 live births by 2030. The extent of neonatal deaths is unacceptably high in sub-Saharan Africa (SSA) and incidentally, the level of healthcare facility for mothers and children in this region is abysmally poor (UN IGME, 2019; World Health Organization, 2015). In sub-Saharan Africa, newborn deaths account for about one-third of the deaths of children under age 5 (UNICEF, 2016). Nigeria ranks second in the world for the highest number of neonatal mortality and very low in the achievement of past development goals (Amoo, 2018; Elem & Nyeche, 2016; UNICEF, 2014). Antenatal care attendance by pregnant women reduces the high rate of infant and maternal mortality in the country through early detection and treatment of pregnancy-related conditions (Fagbeminiyi & Oduaran, 2019; World Health Organization, 2016). Inadequate antenatal care both in terms of coverage and quality has

been associated with adverse pregnancy outcomes (Ajayi & Osakinle, 2013; Fagbemiiniyi & Oduaran, 2019; Ibeh, 2008; Titaley et al., 2010; World Health Organization, 2018b). Hence, it is crucial to increase the coverage of intervention measures before, during and after pregnancy in order to sustain child survival particularly the neonates.

Globally, neonatal mortality (hereinafter refers to as NM) rate has been reported to be declining less rapidly than the mortality rate for children between 1 month and 5 years of age (UNICEF, 2016). Yet, about 2.8 million babies still died in the first month of life as in 2013 (UNICEF, 2014). Besides, cases of infant mortality under this segment are not always captured due to many reasons leading to gross under-reporting in many developing countries, including Nigeria (Hill & Cha, 2006; Oestergaard et al., 2011). Other studies also revealed that NM accounts for almost 40% of under-five child mortality (Etambuyu & Charles, 2015; Titaley et al., 2014).

In Nigeria, NM had been reported to be on a rather slow decline between 2008 NDHS (40 deaths per 1000 live births) and 2013 NDHS (37 deaths per 1000 live births) (National Population Commission, 2014, 2009). This decline might be due to the influence of intervening factors geared towards the reduction of maternal and child morbidity and mortality. One of those factors is said to be the provision of women of childbearing age with antenatal care (hereinafter refers to as ANC) which improves the prospect for safer pregnancy and child survival.

The extant literature reports that there are several programmes in place to ensure maternal and child health. Among such programmes are (1) Committing to Child Survival: Promise Renewed 2012, (2) Road Map for Accelerating the Attainment of the MDGs Related to Maternal and Newborn Health in Nigeria 2005, (4) Integrated Maternal Newborn and Child Health Strategy 2007, (5) National Child Health Policy, (6) Primary Health Care under One Roof, (7) National Health Policy 2016, among others. All of these programs are aimed at reducing maternal, neonatal and child morbidity and mortality. Nevertheless, NM remains high (37 per 1000 live births) in Nigeria (National Population Commission, 2017). Hence, the need to understand the socioeconomic and demographic factors associated with NM. There is need to articulate the proximate factors related to this challenge in order to have evidence-based intervention programs across the geopolitical zones. Therefore, the objectives of the paper are to examine socio-economic factors influencing neonatal deaths and the direct effect of proximate factors on the death of neonates in Nigeria using 2013 NDHS data.

2. Review of literature

According to Mathews et al. (2015), 40% of neonatal deaths could be averted with key interventions around the time of birth. The majority of neonatal deaths in Nigeria occur within the first week of life, reflecting the link of inadequate coverage, low quality of essential obstetric care with maternal and neonatal mortality (Blencowe et al., 2016; Federal Ministry of Health, 2007; UNICEF & WHO, 2015). Babies born to older mothers face a higher risk of NM compared to those born to younger women (UNICEF, 2014). According to NDHS (2013) report, only 36% of births took place in health facilities and 38% of deliveries were attended to by skilled assistants, respectively (National Population Commission, 2014). Ironically, a study conducted by the Federal Ministry of Health (FMOH) revealed that only 18.5% of the 4500 facilities surveyed had the capacity to provide emergency obstetric care (Nigeria Federal Ministry of Health, 2003). Lower household wealth, an uneducated mother and birth in a rural area lower newborn chances of survival within the first 28 days of life (UNICEF, 2014).

The study reported by Adewuyi et al. (2016) has revealed that bio-demographic factors, literacy, and mode of delivery were found to be significant predictors of neonatal mortality. The report issued by UNICEF (2014) and National Center for Health Statistics (2016) also observed that neonatal mortality rates of babies born to mothers with no education are nearly twice as high as those of babies born to mothers with secondary education or higher. UNICEF (2014) has also revealed that family's wealth and geographic location (urban/rural) remain powerful determinants

of inequities in neonatal mortality. Similarly, Yaya et al. (2014) found out that socioeconomic factors affect neonatal mortality, especially among poorest households headed by illiterates and far from the health facility. Another study revealed that neonatal mortality was higher in the poorest families as compared to the wealthier families and the majority of these deaths occurred in rural areas (Kruger et al., 2015; Wang et al., 2016). Whereas place of delivery plays a significant role in predicting neonatal mortality (Eugene & Sdumo, 2012; Jana & Sebastian, 2017; Mazalale et al., 2015), poor social conditions are known to affect maternal health which again has an impact on neonatal mortality (Jana & Sebastian, 2017; Mazalale et al., 2015; Stokowski, 2005). Delivery practices especially during childbirth mostly when delivery takes place at home by untrained birth attendants increase the chances of NM (Ghosh, 2012; World Health Organization, 2018b). Incidentally, in the regions with the highest neonatal mortality rates, access to postnatal care is abysmally low and coverage of key maternal and newborn interventions is too low. Also, one-third of women globally deliver their baby without the help of qualified medical personnel (UNICEF, 2014). In Nigeria, according to NDHS (2013) report, 64% of delivery (births) took place in non-health facilities and 62% of deliveries were not attended to by skilled assistants, respectively (National Population Commission, 2014). Kayode et al. (2014), found a wide variation in neonatal mortality in sub-Saharan due to differences in the quality of healthcare governance, prevalence of HIV and socio-economic deprivation.

In another study by Ajaari et al. (2012), it was found that mothers who delivered outside a health facility experienced more neonatal deaths than those who delivered in a health facility. In the same manner, Fausta (2015) noticed that mothers who had no education experienced neonatal deaths than mothers who had secondary education. Furthermore, some scholars have related maternal and child health status and socio-economic development as vital in the quest for infant survival (Azuh et al., 2017; Egharevba et al., 2016). Also, it has been found that poor maternal health-seeking behavior was high among women who had a low educational background. Lower household wealth, an uneducated mother and birth in a rural area lower a newborn's chances of survival within the first 28 days of life (The Partnership for Maternal, Newborn & Child Health, 2011).

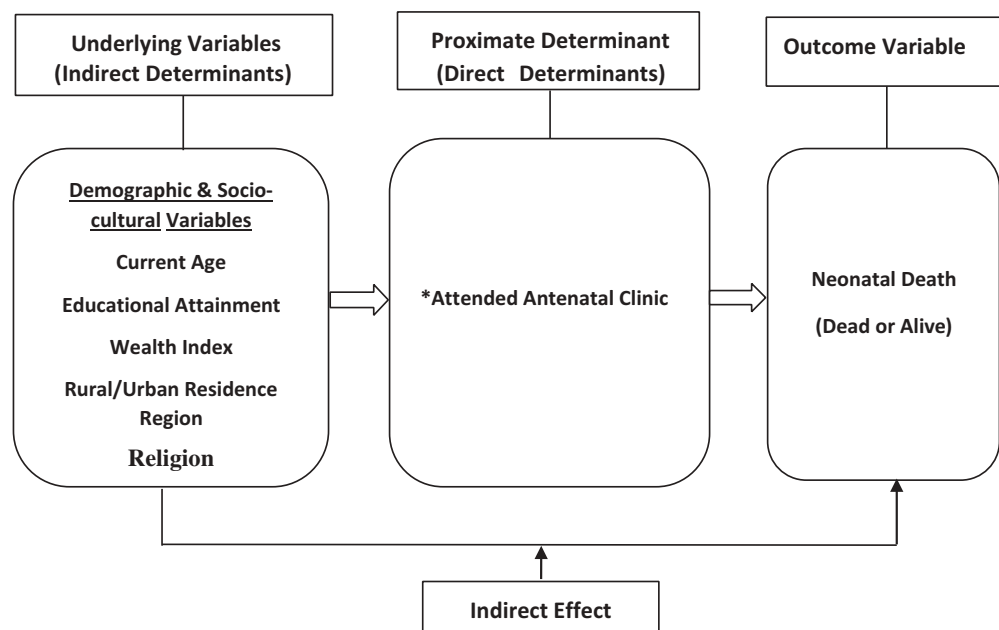
3. Conceptual framework

This study examines the effect of socio-economic, demographic and cultural factors on the impact of mothers' socio-demographic factors, and antenatal clinic attendance on neonatal mortality in Nigeria. The conceptual framework for the study is presented in Figure 1. It uses the principle of "proximate determinants". It was John Bongaarts (1979, 1982) who first used the term in his conceptual and analytic framework to explain how social, economic and environmental variables affect fertility. He defined *proximate determinants of fertility* as the biological and behavioural factors through which social, economic, and environmental variables affect fertility.

Mosley and Chen (1984) had adopted this framework in the "Child Survival" research to explain how socio-economic and environmental factors affect child morbidity and mortality. This analytic framework is also applicable in this study to understand and explain how socio-economic and cultural factors affect the adequate antenatal clinic attendance which helps to reduce neonatal deaths. The three models employed in this study are based on the conceptual/analytical framework that is presented in Figure 1.

The schematic presentation in Figure 1 shows the inter-relationship between explanatory or background variables, the proximate determinants, and the outcome variable. The background variables (i.e., socio-economic, demographic and cultural variables) that are explored in this study include mothers' age, marital status, educational attainment, her occupation, her wealth status, rural/urban residence, her geo-political region, and religion. One proximate determinant that is explored includes attendance of antenatal clinic. The outcome variable is neonatal death.

Figure 1. Interrelationship between background, attended antenatal clinic and neonatal death. Source: Researcher's Compilation (2019).



Looking at the directions of the arrows of influence in Figure 1, the conceptual framework suggests that for any of the background (socio-demographic and cultural) variables to affect death or survival of an infant which occurs within 4 weeks of birth and the health status of the newborn, it must first influence the proximate determinant variable which will then in turn directly influence the death or survival of a new-born. The bottom arrow in the diagram linking the background variables directly to the outcome variable is used to explain the fact that the proximate variable may not be the only one through which some of the background variables influence the death or survival of new-born at the healthcare facility. Hence, the identified proximate determinant may not explain the observed relationship between the background variables and the outcome variable.

4. Methods and materials

The study utilized a secondary data extracted from the 2013 Nigerian Demographic and Health Survey (NDHS). The 2013 NDHS provided information on population and health indicators at the national, zonal and state levels. It is a nationally representative sample designed to elicit information from women aged 15–49 years in randomly selected households across all the states in Nigeria including the Federal Capital Territory (FCT).

The sample design used in the collection of the NDHS data was multi-stage cluster sampling technique. The stages involved the division into state, division of each state into Local Government Areas (LGAs) and dividing local government into different census enumeration areas (EAs). Each enumeration area was further classified into rural or urban and households were randomly selected and interviewed from each location (National Population Commission, 2014). In all, a total sample of 38,385 women aged 15–49 years was interviewed using a structured questionnaire. For the purpose of this study, a sub-sample of 26,826 (weighted) population consisting of women aged 15–49 years whose recent delivery occurred in the 5 years preceding the survey was utilized based on the focus of the study (NDHS, 2013). This represents a total number of women (aged 15 to 49 years) in the reproductive age group as at the time of the study, that had given birth. Mothers were asked to indicate whether or not each of the babies born during the last 5 years survived the first 28 days of life (i.e., neonatal death) and also the number of antenatal visits they attended during each pregnancy. A mother that had four or more visits during a pregnancy was considered to have had an adequate number of visits for that pregnancy, and those who did not attend at all or had less than four visits

a pregnancy was considered to have had inadequate antenatal clinic attendance for that pregnancy. The data were analyzed using STATA 12 computer software. The level of analyses consisted of Univariate, Bivariate, and Multivariate analyses. The direct and indirect associations of the socio-demographic factors of the mothers with neonatal mortality were determined using Binary Logistic Regression. The indirect effect of socio-demographic factors on neonatal mortality was assessed using a “proximate determinant” approach in which “Antenatal Clinic Attendance” was used as the proximate (or intermediate) variable (Mosley and Chen, 1983). This approach assumes that the effects of the socio-demographic factors on neonatal mortality are channeled (or transmitted) through antenatal clinic attendance. The extent or level of significance to which this is true was determined using the Likelihood Ratio (LR) Statistic (Kleinbaum & Klein, 2010). The significant level was set at $P < 0.05$.

5. Results

Table 1 shows the summary statistics of the total births born in the previous 5 years that were reported by the women, according to their socio-demographic characteristics. It also provides information on the antenatal clinic attendance by the women with respect to each of the children born. Visits were categorized into two (i.e., less than four times during pregnancy and before delivery, and four or more times during the pregnancy). The total numbers of neonatal deaths are also indicated in the table. The total number of children reported born during the previous 5 years was 26,826. About 88%, mothers indicated that they attended antenatal clinics between four or more times during the pregnancies.

Table 2 shows the results of the bivariate association of the selected background characteristics of the mothers and their antenatal clinic attendance with the neonatal mortality of the children.

Mother’s age indicated a significant non-linear association with neonatal mortality. It was highest among children of mothers within the aged 25–29 years (25%), drops for children of women aged 30–49 years (56%). The region of residence also has a significant association with neonatal mortality. The rates are higher for North-central, North-east and with North-west regions been the highest (75%) and lower for south-south while south-east and south-west had the lowest (25%). The other characteristics that have a significant bivariate association with neonatal mortality are place of residence (higher in rural areas than urban areas. Neonatal mortality decreases linearly with increasing mothers’ educational level (60 per 1000 for uneducated mothers and 40 per 1000 for mothers with primary, secondary and post-secondary education).

The significant bivariate effects of the six characteristics of mothers on neonatal mortality obtained and presented in Table 2 were subjected to further analyses in order to assess their independent effects on neonatal mortality. This was done using binary logistic regression analysis. Data revealed that out of the six variables considered, only antenatal visits have an insignificant effect with ($P = 0.228$); this may be due to the sample size of the population despite the high level of attendance of more than 4 visits when compared with other five variables with highly significant result in the analysis. This approach was adopted because the outcome variable of interest is neonatal mortality with just two possible outcomes, i.e., Dead or Alive through the first 28 days of life. The results are shown in Table 3.

The Odds of survival of a child beyond 28 days of life are indicated in column 2 of the table, and the levels of significance are shown in column 3. The odd of survival is lowest for children born to women 15–19 years and significantly higher for those children born by mothers 20 years and older ($P < 0.01$), with the exception of mothers within the age group 20–24 with $P = 1.322$. This may be as a result of the closest to the reference category (RC) which is 1.00. Survival through neonatal period is significantly higher for children born in North-central region than for children born in the other five regions ($P < 0.05$). Also, survival is significantly higher for those children born in urban areas than those born in the rural areas ($P = 0.005$). Education of mothers no longer has significant

Table 1. Frequency distribution of neonatal deaths (in the previous 5 years) reported by the mothers, by their socio-demographic characteristics and health seeking behaviour

| Socioeconomic and demographic variables | Frequency | Percentage | Variables | Frequency (26,826) | Percentage |
|---|-----------|------------|--|--------------------|------------|
| Age group | N | (%) | Religion | | |
| 15–19 | 744 | 2.77 | Christianity | 9,149 | 34.10 |
| 20–24 | 3,251 | 12.12 | Islam | 17,264 | 64.36 |
| 25–29 | 6,633 | 24.73 | Traditionalist | 413 | 1.54 |
| 30–34 | 6,789 | 25.31 | | | |
| 35–39 | 5,697 | 21.24 | Wealth index | | |
| 40–44 | 2,741 | 10.22 | Poorest | 7,138 | 26.61 |
| 45–49 | 971 | 3.62 | Poorer | 6,736 | 25.11 |
| | | | Middle | 5,318 | 19.82 |
| Region | | | Richer | 4,456 | 16.61 |
| North Central | 3,379 | 12.60 | Richest | 3,178 | 11.85 |
| North East | 6014 | 22.42 | | | |
| North West | 9,923 | 36.99 | Antenatal visit behaviour and neonatal mortality | | |
| South East | 2,103 | 7.84 | Number of antenatal visits | | |
| South South | 2,896 | 10.80 | Less than 4 visits | 3,156 | 11.76 |
| South West | 2,511 | 9.36 | 4 and more | 23,670 | 88.24 |
| Highest level of education | | | Neonatal mortality status | | |
| No education | 14,502 | 54.06 | Neonatal death | 1,204 | 4.49 |
| Primary | 5,632 | 20.99 | Survivors | 25,622 | 95.51 |
| Secondary | 5,613 | 20.92 | | | |
| Higher | 1,079 | 4.02 | | | |
| Place of residence | | | | | |
| Urban | 7,786 | 29.02 | | | |
| Rural | 19,040 | 70.98 | | | |

Source: Computed by the authors from the 2013 NDHS.

independent effects on survival through neonatal period ($P > 0.05$). The wealth status categories do not have any significant difference in their survival rates ($P > 0.05$).

In Table 4, we examined the bivariate relationship between socioeconomic and demographic characteristics of the mothers and their level of antenatal clinic attendance. Mothers who attended antenatal clinics four or more times are considered to have adequate visits compared to those who did not attend at all or attended less than four times were considered to have inadequate attendance. All the variables have a significant bivariate association with clinic attendance. The older a woman is the more likely that she would have adequate clinic attendance ($P < 0.001$). Also, adequate clinic attendance varies with the geographical regions. Women in Northeast and Northwest regions have significantly lower clinic attendance than women in the other four regions of the country ($P < 0.001$). Urban women had significantly higher attendance rate than women in rural areas ($P < 0.001$). Also, the higher the level of education, the more is the level of antenatal clinic attendance ($P < 0.001$). Finally, the higher the wealth status of a woman,

Table 2. Bivariate association of socio-economic and demographic characteristics and antenatal clinic attendance of mothers with neonatal mortality

| Variables | Neonatal death | Survivors | Chi-square | P-value |
|---------------------------|----------------|----------------|------------|---------|
| Age group | N (%) | N (%) | | |
| 15–19 | 58 (7.80) | 686 (92.20) | | |
| 20–24 | 164 (5.04) | 3087 (94.96) | | |
| 25–29 | 30 (4.60) | 6,328 (95.40) | | |
| 30–34 | 259 (3.82) | 6,530 (96.19) | | |
| 35–39 | 259 (4.55) | 5,438 (95.45) | | |
| 40–44 | 131 (4.78) | 2,610 (95.22) | | |
| 45–49 | 28 (2.89) | 943 (97.12) | 52.1456 | 0.000 |
| Region | | | | |
| North Central | 129 (3.82) | 3,250 (96.18) | | |
| North East | 301 (5.00) | 5,713 (95.00) | | |
| North West | 471 (4.75) | 9,452 (95.25) | | |
| South East | 98 (4.66) | 2,005 (95.34) | | |
| South South | 107 (3.69) | 2,789 (96.31) | | |
| South West | 98 (3.90) | 2,413 (96.10) | 50.3583 | 0.000 |
| Place of residence | | | | |
| Urban | 273 (3.51) | 7,513 (96.49) | | |
| Rural | 931 (4.89) | 18,109 (95.11) | 26.3101 | 0.000 |
| Highest educational level | | | | |
| No education | 723 (4.99) | 13,779 (95.01) | | |
| Primary | 244 (4.33) | 5,388 (95.67) | | |
| Secondary | 210 (3.74) | 5,403 (96.26) | | |
| Higher | 27 (2.50) | 1,052 (97.50) | 41.5982 | 0.000 |
| Wealth index | | | | |
| Poorest | 359 (5.03) | 6,779 (94.97) | | |
| Poorer | 345 (5.12) | 6,391 (94.88) | | |
| Middle | 230 (4.32) | 5,088 (95.68) | | |
| Richer | 164 (3.68) | 4,292 (96.32) | | |
| Richest | 106 (3.34) | 3,072 (96.66) | 42.9657 | 0.000 |
| Antenatal visits | | | | |
| Less than 4 visits | 125 (3.96) | 3,031 (96.04) | | |
| 4 or more visits | 1,079 (4.56) | 2,2591 (95.44) | 2.9525 | 0.228 |

Source: Computed by the authors from the 2013 NDHS.

the higher the level of clinic attendance ($P = 0.001$). These results indicate that all these socio-demographic variables are having significant direct effects on antenatal clinic attendance.

In the previous analysis in Table 4, we confirmed that all the socio-demographic and economic variables of mothers had significant bivariate direct effects on antenatal clinic attendance. To what extent does antenatal clinic attendance help to channel or transmit the effects of the socio-demographic variables on neonatal mortality? The answer to this question is provided in the results of the analysis in Table 5.

The analysis in Table 5 is identical to that of Table 3, with the exception that in Table 5, the proximate determinant variable, i.e., antenatal clinic attendance, is included in the model as

Table 3. Binary logistic regression model for neonatal mortality controlling for selected background characteristics

| Variables | Odds ratio | P-value | Std error | Confidence interval (95%) |
|---------------------------|------------|---------|-----------|---------------------------|
| Current age | | | | |
| 15–19 (RC) | | | | |
| 20–24 | 1.322 | 0.121 | 0.238 | (0.929 1.883) |
| 25–29 | 1.765 | 0.001 | 0.305 | (1.258 2.477) |
| 30–34 | 1.967 | 0.000 | 0.343 | (1.398 2.768) |
| 35–39 | 1.813 | 0.001 | 0.318 | (1.286 2.556) |
| 40–44 | 1.717 | 0.005 | 0.327 | (1.182 2.492) |
| 45–49 | 3.522 | 0.000 | 1.050 | (1.963 6.318) |
| Region | | | | |
| North central (RC) | | | | |
| North east | 0.637 | 0.001 | 0.086 | (0.489 0.830) |
| North west | 0.789 | 0.073 | 0.105 | (0.608 1.023) |
| South east | 0.521 | 0.000 | 0.087 | (0.375 0.723) |
| South west | 0.691 | 0.018 | 0.107 | (0.509 0.938) |
| South South | 0.687 | 0.026 | 0.116 | (0.494 0.956) |
| Place of residence | | | | |
| Urban (RC) | | | | |
| Rural | 0.758 | 0.005 | 0.075 | (0.624 0.920) |
| Highest educational level | | | | |
| No education (RC) | | | | |
| Primary | 1.043 | 0.672 | 0.105 | (0.857 1.270) |
| Secondary | 1.222 | 0.105 | 0.151 | (0.959 1.556) |
| Higher | 1.469 | 0.116 | 0.360 | (0.909 2.374) |
| Wealth index | | | | |
| Poorest (RC) | | | | |
| Poorer | 0.937 | 0.492 | 0.088 | (0.780 1.127) |
| Middle | 0.902 | 0.362 | 0.102 | (0.724 1.125) |
| Richer | 0.988 | 0.929 | 0.136 | (0.755 0.293) |
| Richest | 0.892 | 0.521 | 0.159 | (0.629 1.265) |

Source: Computed by the authors from the 2013 NDHS.

Notes: Number of observations = 26,826; LR χ^2 (19) = 71.01; Prob > χ^2 = 0.0000; pseudo R^2 = 0.0091; log likelihood = -3860.6998.

a dependent variable along with the socio-demographic variables. The importance or significance of the antenatal clinic attendance as a channel through which the sociodemographic factors influence neonatal mortality is determined from the results from Tables 3 and 5 by using the Likelihood Ratio (LR) test. This is the difference between the Log Likelihood Statistic (LLS) in Table 3 and the LLS in Table 5 (Kleinbaum & Klein, 2010). Likelihood Ratio test uses a Chi-square statistic, with the degree of freedom equal to the number of parameters from the added proximate variable(s) in the final results.

The result in Table 5 indicates a decrease in neonatal mortality rate among children whose mothers had adequate antenatal clinic attendance (four or more visits), when compared to those whose mothers had less than four visits (Odds Ratio = 0.756, P = 0.015). Using the Likelihood Ratio (LR) test, the difference in the Log Likelihood Statistic from Tables 3 and 5 is (3860.6998–3857.5883) = 3.1115 on

Table 4. Bivariate association of socio-economic and demographic characteristics and antenatal visits

| Variables | Less than 4 | 4 or more | Chi-square value | P-value |
|---------------------------|-----------------|----------------|------------------|---------|
| Age group | (N = 3,156) (%) | N (%) | | |
| 15–19 | 348 (46.77) | 396 (53.23) | | |
| 20–24 | 747 (22.98) | 2,504 (77.02) | | |
| 25–29 | 849 (12.80) | 5,784 (87.20) | | |
| 30–34 | 572 (8.43) | 6,217 (91.57) | | |
| 35–39 | 385 (6.76) | 5,312 (93.24) | | |
| 40–44 | 183 (6.68) | 2,558 (93.32) | | |
| 45–49 | 72 (7.42) | 899 (92.58) | 1.6e+03 | 0.000 |
| Region | | | | |
| North Central | 348 (10.30) | 3,031 (89.70) | | |
| North East | 772 (12.84) | 5,242 (87.16) | | |
| North West | 1,560 (15.72) | 8,363 (84.28) | | |
| South East | 80 (3.80) | 2,023 (96.20) | | |
| South South | 304 (10.50) | 2,592 (89.50) | | |
| South West | 92 (3.66) | 2,419 (96.34) | 454.8818 | 0.000 |
| Place of Residence | | | | |
| Urban | 483 (6.20) | 7,303 (93.80) | | |
| Rural | 2,673 (14.04) | 16,367 (85.96) | 326.8338 | 0.000 |
| Highest educational level | | | | |
| No education | 2,179 (15.03) | 12,323 (84.97) | | |
| Primary | 521 (9.25) | 5,111 (90.75) | | |
| Secondary | 430 (7.66) | 5,183 (92.34) | | |
| Higher | 26 (2.41) | 1,053 (97.59) | 364.8714 | 0.000 |
| Wealth Index | | | | |
| Poorest | 1,184 (16.59) | 5,954 (83.41) | | |
| Poorer | 1,005 (14.92) | 5,731 (85.08) | | |
| Middle | 536 (10.08) | 4,782 (89.92) | | |
| Richer | 321 (7.20) | 4,135 (92.80) | | |
| Richest | 110 (3.46) | 3,068 (96.54) | 539.4517 | 0.000 |

Source: Computed by the authors from the 2013 NDHS.

1 degree of freedom, $P < 0.01$. This means that antenatal clinic attendance significantly explains the indirect effects of socio-demographic characteristics of mothers on neonatal deaths of their children. In other words, it is an important channel through which mothers' socio-demographic characteristics influence neonatal mortality.

6. Discussion

The study highlighted the relevance of antenatal clinic attendance with emphasis on institutional delivery for plausible achievement of UN-Sustainable Development Goals, particularly, the Goal3. The study is an extension of existing literature with focus on antenatal attendance (). The study, among others, acknowledged the various existing intervention on reduction of neonatal deaths and improvement on women health but re-confirmed the unacceptable high level of infant mortality (). Specifically, in Nigeria, the current situation could lead to assumption that national efforts have not yielded desired acceleration on maternal and child survival (Adetoro & Amoo, 2014; Amoo, 2018; UN IGME, 2019; WHO, 2019). The analysis of 2013 Nigeria Demographic and

Table 5. Binary logistic regression model for neonatal mortality controlling for selected background characteristics and number of antenatal visits

| Variables | Odds ratio | P-value | Std error | Confidence interval (95%) |
|----------------------------|------------|---------|-----------|---------------------------|
| Current age | | | | |
| 15–19 (RC) | | | | |
| 20–24 | 1.404 | 0.062 | 0.255 | (0.983 2.005) |
| 25–29 | 1.925 | 0.000 | 0.339 | (1.363 2.718) |
| 30–34 | 2.170 | 0.000 | 0.387 | (1.529 3.078) |
| 35–39 | 2.011 | 0.000 | 0.362 | (1.414 2.860) |
| 40–44 | 1.908 | 0.001 | 0.371 | (1.303 2.794) |
| 45–49 | 3.921 | 0.000 | 1.181 | (2.173 7.076) |
| Region | | | | |
| North Central (RC) | | | | |
| North East | 0.638 | 0.001 | 0.086 | (0.489 0.831) |
| North West | 0.783 | 0.066 | 0.104 | (0.604 1.016) |
| South East | 0.525 | 0.000 | 0.088 | (0.378 0.728) |
| South West | 0.685 | 0.015 | 0.107 | (0.504 0.930) |
| South South | 0.692 | 0.029 | 0.117 | (0.498 0.963) |
| Place of residence | | | | |
| Urban (RC) | | | | |
| Rural | 0.755 | 0.004 | 0.075 | (0.622 0.916) |
| Highest educational level | | | | |
| No education (RC) | | | | |
| Primary | 1.051 | 0.618 | 0.105 | (0.864 1.280) |
| Secondary | 1.234 | 0.089 | 0.153 | (0.969 1.573) |
| Higher | 1.484 | 0.107 | 0.363 | (0.918 2.398) |
| Wealth index | | | | |
| Poorest (RC) | | | | |
| Poorer | 0.941 | 0.518 | 0.088 | (0.783 1.132) |
| Middle | 0.914 | 0.422 | 0.103 | (0.733 1.139) |
| Richer | 1.004 | 0.979 | 0.138 | (0.767 1.314) |
| Richest | 0.908 | 0.589 | 0.162 | (0.640 1.288) |
| Number of antenatal visits | | | | |
| Less than 4 visits (RC) | | | | |
| 4 and more | 0.756 | 0.015 | 0.087 | (0.603 0.948) |

Source: Computed by the authors from the 2013 NDHS.

Notes: Number of observations = 26,826; LR chi 2 (20) = 77.23; Prob > chi 2 = 0.0000; pseudo R² = 0.0099, log likelihood = -3857.5883.

Health survey using a birth recode data has brought to limelight the likely significant contribution of socio-economic and demographic factors such as age, region, education, wealth index and place of residence on neonatal mortality and health seeking behaviour.

The study results revealed that almost nearer to a one-quarter of the neonatal death surveyed in the age group lies within the range 25–39 years old who had responded with a higher number representing (24.73%, 25.31%, and 21.24%, respectively). Education has a pivotal function with respect to women independence and improved status. Poor quality of education affects

maternal-related issues leading to deaths among neonates as confirmed by similar other studies (Adewuyi et al., 2016; Fasina & Oni, 2017; Fausta, 2015; UNICEF, 2014; Yaya et al., 2014). This is evident where about 52% of the respondents are in the poor category. Poverty retards decision, makes women depend more on their husbands and prevents better access to health care or even timely intervention during an emergency which is in consonance with other earlier studies (Kruger et al., 2015; Lawn et al., 2005; Stokowski, 2005; UNICEF, 2014). Furthermore, the poor socio-economic status of respondents is worrisome in a place like Nigeria, where it retards access to healthcare services among these categories of women and promotes “dependency syndrome” of wives according to the previous study (Azuh et al., 2017) leading to increase the chance of neonatal and maternal mortality as validated by such other earlier studies (Adetoro & Amoo, 2014; Fagbiminiyi & Oduaran, 2019; National Population Commission, 2014; Oni & Fasina, 2017; Samuel & Oni, 2017) particularly among those women who had low educational background (Ayotunde et al., 2015). Antenatal care is a major component of reproductive health care and consists of prenatal, natal and postnatal care which aims at reducing infant and maternal morbidity and mortality through early detection of complications and prompt treatment, prevention of diseases, birth preparedness and health promotion. The Antenatal care pattern in Nigeria is according to the World Health Organization which stipulates four visits for women without complications while emphasizing high-quality care at each visit. In addition, ANC period is an opportune time for reaching pregnant women with a number of additional interventions that may be vital to the health and well-being as well as to the health of their unborn children. It involves the percentage increase or frequency in the number of visits for antenatal care and delivery place. It also promotes hospital or facility-based continuum of care during pregnancy and childbirth. While nearly three-quarter of the respondents (88.24%) avail themselves four or more antenatal visits which is in line with WHO recommendation as indicated previously, some proportion of them (11.76%) made less than four visits which are dangerous with respect to poor knowledge of pregnancy complications, disease prevention, low birth preparedness and poor state of health facility in Nigeria. Also, we found that all the background variables indicated significant indirect effects on the outcome variable which will aid guided intervention measures towards the reduction of deaths among the neonates in Nigeria.

7. Conclusion and recommendations

The study revealed significant relationships between socioeconomic and demographic factors and neonatal mortality. These socio-economic and demographic factors operated through a common proximate determinant that is, the number of ANC visits to affect neonatal mortality. ANC visits have been proven by the study to be effective in reducing neonatal deaths. The study highlights some of the multiple factors associated with perceived deaths among neonates. To accelerate the survival of neonates in the study area, a combined assault on both socio-economic and demographic determinants is crucial. Hence, the study recommends that there should be adequate provision of effective maternal and child healthcare services and enhances utilization of those services by women and children and government should ensure plans to improve healthcare services for maternal and new-borns covering from antenatal to delivery needed to reduce neonatal mortality across regions in the country.

Acknowledgements

The authors would like to sincerely and deeply appreciate Covenant University Centre for research, Innovation and Discovery (CUCRID) for the financial support and final publication of this paper.

Funding

The authors received no direct funding for this research.

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Cite This Paper As

Fasina Fagbiminiyi F, Oni Gbolahan A, Azuh Dominic E. & Akpovire Oduaran B (2020). Impact of mothers' socio-demographic factors and antenatal clinic attendance on neonatal mortality in Nigeria. *Cogent Social Sciences* ...

Citation information

Cite this article as: Impact of mothers' socio-demographic factors and antenatal clinic attendance on neonatal mortality in Nigeria, Fagbemiiniyi Fasina, Gbolahan Oni, Dominic Azuh & Akpovire Oduaran, *Cogent Social Sciences* (2020), 6: 1747328.

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